The Mechanics of the Gig Economy: A System Dynamics Approach

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Abstract. As organizations look to become leaner, more workers find themselves in the role of an independent contractor participating in the gig economy. This research describes the creation of a design science artifact that captures dynamic and systemic relations between the conventional and gig economy. Considering the gig economy's disruptive impact on the labor market, this research focuses on the role of platform effectiveness and relative pricing in on the dual economies. It seeks to contribute to the extant literature by capturing the complex and dynamic aspects of the two parallel economies. Ongoing work and future plans are outlined and formulated.

Keywords: Online platform economy · Gig economy · Labor market · System dynamics · Simulation

1 Introduction

Over the last decade, the gig economy has become increasingly significant in the labor marketplace. Estimates indicate independent workers comprise up to 20% of the paid workforce in some countries [9] and 16% in USA [20]. This disruption to the traditional workforce is enabled by the availability of online platforms that connect customers to providers. The attraction of being one's own boss, and settings one's own hours has allowed competent service providers to remove themselves from the traditional workforce and pick and choose assignments as freelancers. What originally began as a small coterie of marketplaces connecting independent sellers to buyers of physical goods has morphed into a wide range of online platforms spanning multiple sectors including transport (delivery, moving), personal service (dog walking, repairs, babysitting, home healthcare), and selling (trading physical goods) [4]. In this research, we treat the gig economy as distinct from the sharing economy in that the former focuses on services, while the latter includes assets like apartments, rooms, parking spaces, storage space, automobiles, etc. The transition to the gig economy is not without risk, though. Participants give up corporate benefits and need to plan for the uncertainty of future work.

A. Garimella et al. (Eds.): WeB 2020, LNBIP 418, pp. 59–66, 2021.
https://doi.org/10.1007/978-3-030-79454-5_6

However, nimble participants have adapted to take on a variety of jobs to fill the gaps between steady assignments. Motivations for entering the gig economy vary, including autonomy, work-life balance, extra earnings, working between jobs, and the only available option in some cases. Gig workers are classified as free agents, reluctants, casual earners, and financially strapped, based upon their choice and need for income [9].

Some advocates of the gig economy have made sweeping claims about the end to traditional employment, and a shift to a predatory platform driven paradigm. This shift has not come to pass in that the gig economy still represents a small part of the labor economy. More recently, the literature has recognized this as a labor issue that raises challenging questions [18]. One of the key questions that arises is whether online platforms are distinct from conventional work in the labor market. It has been suggested that there is need for research on the systemic relationship between the conventional and gig economies [18]. Given the prevailing organizational, environmental, and contextual factors, this proves to be a challenging area, in light of the complexity and dynamism of the problem domain. Disruptions in the labor market can be triggered by a variety of phenomena, including economic crises, natural disasters, sustained climate issues, military strife, and more recently, the Covid-19 pandemic. Interestingly, the pandemic has forced many traditional workers to adopt the work patterns of providers in the gig economy.

In an effort to better understand the effect of the gig economy, this research utilizes the design science methodology [6], which seeks to create artifacts that are intended to address specific organizational problems and provide rigorous evaluation of these artifacts based on utility rather than an empirical test of theories.

Following the design science process outlined in [13], this paper presents the initial steps taken in developing an artifact that captures dynamic and systemic relation between the conventional and gig economies. The paper is organized as follows. A review of the extant literature pertaining to gig economy and enabling online platforms serves as the foundation for building the model and is presented in the next section. Objectives for a model that will shed light on the implications of the gig economy are then addressed. A dynamic model of the constructs underlying the gig economy and its associated labor market is then assembled and presented. Ongoing work and future plans are formulated and discussed.

2 Prior Studies and Problem Characteristics

The gig economy has been defined as people using platforms to sell their labor [17]. Studies have identified several distinctive types of platforms. Some researchers have categorized them based on their objectives, including platforms for platforms, platforms for digital tools, platforms mediating work, retail platforms, and service-providing platforms [8]. Others have focused on the role of individuals in the platform, identifying platform architects, cloud-based consultants, freelancers, service providers, workers involved in online micro-tasking, content producers, and social media influencers [18].

Some studies have adopted a more utopian perspective, emphasizing the ability of peer-to-peer connections to erode the dominance of the conventional corporate model [3]; the monetization of assets through sharing platforms to reduce dependency on labor

income [16]; reduced transaction cost through crowd-source ratings and reputational information [16]; or an emerging networked society of microentrepreneurs where workers are afforded the flexibility and choice that is generally available to nonprofessionals in conventional jobs [14, 16].

Others adopt a more dystopian view, focusing on workforce control though information technologies and related algorithms. These researchers have focused on technology's role in surveillance [21], the usage of people analytics in corporate human resource management [2], unfair outcomes in evaluation and ranking systems, disproportionally affecting race and gender [10], and developments in undermining transparency [12], among others.

The reality lies somewhere in between. Kalleberg [7] suggested that the growth of "market-mediated, open employment relationships" entails the replacement of administrative rules with market mechanisms for determining job outcomes. Further, he argued that it shifts economic risks and responsibility for skill development onto workers while firms are no longer willing to provide training for their workforce. Market-mediated open employment relationships have been seen as enabling a new wave of online outsourcing in low and middle-income countries. It is posited this is due to workers not having the opportunity to benefit from closed employment relationships and be granted certain legal rights and guarantees over labor conditions [19]. Eventually, researchers sought to investigate the notion of job quality employing multiple dimensions in market-mediated, open employment relationships to highlight the attractive features of gig jobs in comparison to traditional ones. Some studies adopted a multi-pronged approach to identify characteristics and mechanisms in platform-enabled gig jobs. In addition, they also explored the causes of lower income (e.g. the high ratio of unpaid work to paid labor, unavailability of work), issues involving lack of employment-linked social security, worker's control at the place of work, or higher uncertainty relevant to gig jobs [1].

3 Solution Characteristics and Design Methodology

The design science process includes successive tasks of problem identification, objective formulation, design and development, demonstration, evaluation, and communication [13]. The prior section identified the problem, and this section is devoted to specifying the objectives for the artifact. Understanding the effects of the gig economy requires a systematic exploration of its impacts under a variety of conditions. The complexity of labor markets and the dynamic nature of platform phenomenon make it difficult to assess the implications of gig job characteristics, and to determine which set of parameters would lead to more efficient labor markets. Attempting to explore the impact of different gig job characteristics in a real-world setting would require a large number of field experiments. In an attempt to understand the gig economy more effectively, this research adopts a simulation-based approach that permits controlled manipulation of the relevant constructs.

The predictive capability of the model represents one of the foremost objectives in this research. The ability to examine the impact of alternative options under various environmental and organizational conditions provides managers with guidance when

making the decisions central to the gig economy and workforce outsourcing. Additionally, the solution approach must adequately represent the real-world phenomenon, be robust, and reliable. The artifact in this research is a system dynamics model that allows decision makers to evaluate the impact of alternative human resource decisions under varying environmental and industry conditions.

This use of a system dynamics model permits the investigation of the effects of different decisions and environmental conditions on an organization's workforce. System dynamics uses a combination of first order linear and non-linear difference equations to relate qualitative and quantitative factors within and across time periods [15] and is based on principles developed by Forrester to study managerial and dynamic decisions using control principles [5]. System dynamics was chosen for the simulation as it permits examination of the relationships between constructs within a time period, as well as across time periods. System dynamics models comprise stocks, flows, converters, and connectors. Stocks represent organizational resources that can accumulate or deplete over time. Stocks are connected by flows, which increase or deplete the stock levels, through resource utilization and replenishment. Stocks and flows are governed by conserving laws, which ensure that future stock levels are based on current levels, moderated by all flows. In contrast to stocks, converters hold inputs, outputs, and intermediate values and do not accumulate values. Converters are linked to other constructs using connectors. Positive or self-reinforcing and negative or self-correcting feedback loops play an important role in determining dynamic behavior because most complex behaviors usually arise from feedback among the system components, not from the complexity of the components [15].

4 Design of the Gig Economy Model

The model seeks to capture the relationships in the labor market when some of its work is outsourced through online platforms, and represents the third step in the design science process. The foremost decision to be made is the unit of analysis for the model. Several options are available, including modeling at the level of the gig economy worker, the platform, the industry, or the national labor market. Model constructs and their relationships will differ, depending on the level selected. In this case, we elect to study the phenomenon at the industry level. Models at the individual and platform levels are less likely to be generalizable, while the entire labor market will entail wide disparity in constituent industries. Estimates of gig work in USA range from 38% in recreation to 2% in manufacturing [20]. In addition, modeling at an industry level would facilitate greater insights. When assembling a system dynamics model, the construction and validation procedures are closely interwoven. Creating the model requires the identification of stocks, converters, flows, and connectors that are intrinsic to the model. Textual analysis of published academic and professional literature facilitates the initial identification of these concepts. The process is repeated, and the model evolves iteratively. Much of the art of system dynamics modeling is discovering and representing the feedback processes. Application of these principles to the gig economy at the industry context results in the causal model depicted in Fig. 1.

The key constructs in the model are companies and individuals that participate in the gig economy, and the price of the gig projects relative to traditional workers. The number

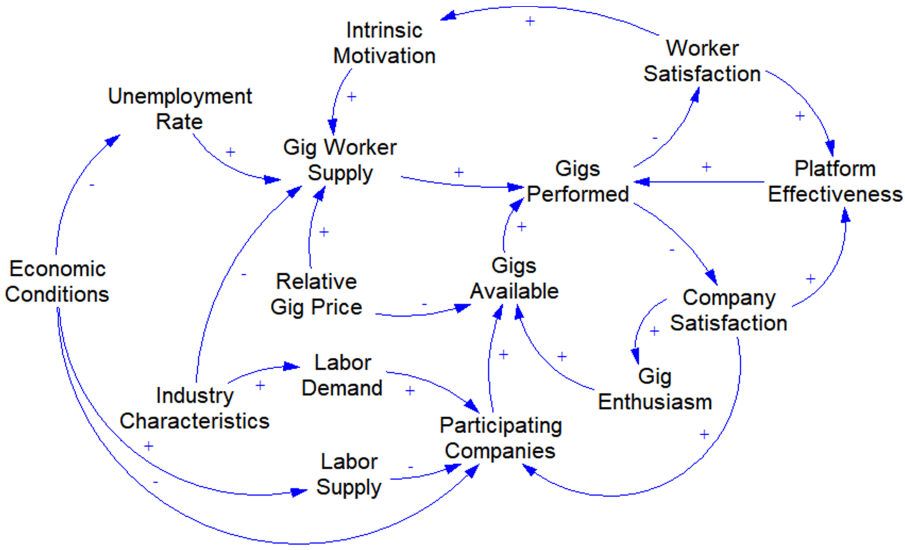

Fig. 1. Platform-enabled gig economy model

of companies participating in the gig economy is shaped by the demand and supply of labor, moderated by prevailing economic conditions. While it is generally accepted that gig worker wages will be lower than traditional workers, companies that are squeezed financially may opt for more gig work. In contrast, some industries may preclude significant gig work, due to regulations, confidentiality, liability considerations, and client preferences. A combination of environmental conditions and industry characteristics will shape the precursors to the number of companies participating. Also of importance is the degree of familiarity and enthusiasm associated with outsourcing gig work by the company. Not all companies within an industry will have the same enthusiasm for participation. These two constructs will shape the number of gig opportunities available. Another segment of the model deals with the gig workers. The motivation for gig work includes work autonomy, work-life balance, extra earnings, working between jobs, and the lack of other options. Coupled with the prevailing unemployment rate, this will shape the number of workers seeking to enter the gig economy. A crucial part of the model is the relative price of gig work. This affects the number of gig jobs, as well as the number of gig workers. Lower rates will boost the number of jobs, while depressing the number of workers. Estimates for short term gig worker pay hover around 40% of traditional workers, while experienced and skilled individuals hired as contractors may earn comparable or greater paychecks than employees. However, in both cases, the overall cost to the company is lowered since benefits and other expenses associated with full-time employees are obviated. The last segment of the model relates to platform effectiveness. Without an efficient and competent platform, matching between gig workers and opportunities will be problematic. Satisfaction with the gig experience for the worker as well as the company forms the basis for feedback loops in the model.

A critical aspect of the model is the presence of feedback loops. In this case, there are loops that address gig worker availability, company participation, and platform effectiveness. All these loops are balancing loops, ensuring that the model will not display unfettered growth or decline.

5 Future Research

5.1 Model Development and Validation

While the causal diagram provides a sense of how constructs in the gig economy are related, the real utility is manifest when it is transformed into a working model. This represents the next step in the research, and entails describing detailed relationships between the causal links. Model equations are assembled in parameterized form, so as to permit exploration of a number of scenarios and generate results that are not restricted to a specific organizational context. Difference equations in the relationships are incorporated to ensure that the model adequately reflects reality. Equations will be assembled based upon findings from published literature.

Validation of the model represents an integral part of its construction. Validation is accomplished on two distinct dimensions. Structural validation of the model seeks to determine if it reflects the real world accurately, while behavioral assessment focuses on the model behavior during execution and assesses the degree of confidence that can be placed in the results. Structural validation involves tasks of boundary adequacy, structure verification, parameter verification, dimensional consistency, and extreme condition analysis [11]. These tasks serve to ensure that relevant constructs are included in the model, the structure represents relationships from the real world, the parameters and dimensions are consistent with traditional notions, and that the model is robust under a variety of conditions.

Validation of individual equations is easily accomplished through suitable calibration and methodical assessment of the response under all valid combinations of inputs. However, validation of the entire model is considerably more complex, and correct functioning of individual equations does not guarantee adequate performance of the model. Once again, an iterative process is adopted. Testing the model in a variety of organizational and environmental conditions allows for systematic exploration of the model behavior. Some of the behavioral assessment is aimed at ensuring that basic system dynamic principles are not violated, e.g. stock values do not go negative. Other aspects deal with behavior patterns. The working model will include loops, and any reinforcing loops need to be checked for rapid trends towards zero or unacceptably high values. Similarly, in a balancing loop, it is necessary to verify that there are no unacceptable oscillations, and that any oscillations are suitably damped. Finally, the model is checked for behavior patterns that are consistent to the real world, examining trends and how quickly a variable achieves stability, rather than focusing on specific values generated through the simulation. Recalibration of the model equations and parameters facilitates the construction of a more accurate and robust model.

5.2 Application to Real-World Cases

The next two steps of the design science process are accomplished through application to real-world cases. This involves setting the context and the scope of the application. The scope could be regional, national, or global. The context specifies whether the application is limited to one platform, an entire industry, or all industries. The larger the scope and the wider the context, the less precise the model will be. Narrow scopes and limited contexts offer restricted insights and fewer opportunities to generalize the findings. Regardless of the scope and context selected, the model needs to be calibrated suitably. Aside from the overall magnitude of the numbers involved, the perceived attractiveness for workers and the relative substitutability for organizations will also need to be adjusted. Our preference is to run the model for a specific industry at a national level. The model would not consider work performed by overseas providers, since that involves foreign transaction as well as legal ramifications.

Running the model requires a systematic exploration of the problem space, by varying individual inputs in a controlled manner. In addition to examining the effect of specific inputs, e.g. various price points for gig work, we also plan to examine the effect of different environmental conditions, e.g. stagnant, contracting, or growing economies. This would offer deeper and broader insights into the gig economy within the selected industry.

6 Conclusions

The concept of freelance work has long predated the gig economy – substitute teachers, float nurses, are well-established examples. However, the gig economy made these exchange opportunities more efficient. While the gig economy has made some inroads into the traditional labor markets, it is unclear if it will play a sizeable role in the future. Nevertheless, it is here to stay. This research seeks to understand the mechanics of gig economy. The initial steps towards formulating a causal diagram in system dynamics are described, and subsequent development of the model is outlined. The current work and subsequent steps will contribute to knowledge on the gig economy, capturing the dynamic interplay of the labor market in the gig and traditional economies.

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